

モード（第2のモード）との2通りがあり、これらの各モードがエンジンの運転態様に依り切り換えられるようになっている。そして、本実施形態では、エンジンにそなえらるる全気筒のうち、半数の気筒については、第1のモードのみ実行しようように構成され、残りの半数の気筒については、第2のモードのみ実行しようようになっている。

【0013】また、第1のモードと第2のモードとでは、サブ排気を行なうのに適したタイミミングが与えらるるが異なる。つまり、本実施形態では、それぞれモードにおいて適切なタイミミングでサブ排気が行なわれるように、第1のモードを実行しようする気筒の可変動弁機構60Aと、第2のモードを実行しようする可変動弁機構60Aとでは、その特性が異なるように構成されている。

【0014】また、第1のモード及び第2のモードは、選択的に何れか一方のモードのみが実行されるように構成されている。これにより、サブ排気を行なうのは、エンジンの半数の気筒のみとなり、急激なエンジントルクの低下が防止されるようになっている。つまり、膨張行程中に排ガスを排出するということは、筒内のピストン31を押し下げてエンジントルクを発生させる膨張ガス7を早期に排出してしまうことであるため、エンジントルクの損失につながり、したがって、触媒6の昇温を行なうときにおいても、サブ排気を行なうのは、エンジン半数の気筒のみとして、急激なエンジントルクの低下が生じないようにしている。

【0015】なお、可変動弁機構60A及び動弁機構60Bについては後述する。ところで、図1及び図2に示すように、このエンジンには、触媒温度センサ3A、冷却水温センサ71、アクセルポジションセンサ（AP）72、クランク角センサ73、アイドルスイッチ74、カム角センサ75等の個々のセンサが設けられており、各センサからの検出信号はECU20へ送られるようになっている。

【0016】触媒温度センサ3Aは、触媒6内に設けられており、触媒6内の温度（触媒温度） T_{wc} を検出するものである。また、冷却水温センサ71は、右バンクと左バンクとの間のシリンダブロック内に設けられたウォータジャケット30Bに挿設されており、エンジン冷却水温 T_w を検出するものである。また、アクセルポジションセンサ72は、エンジン負荷としてのアクセル開度 θ_a を検出するものである。そして、クランク角センサ73はクランクシャフト5に設けられ、エンジン回転数 N_e を検出するものである。また、アイドルスイッチ74はアイドル状態時にアイドル検出信号Pを出力するものである。

【0017】また、本エンジンでは、その運転モードとして、圧縮行程中に燃料を噴射し、燃焼室1内に流入した吸気流を、ピストン31前面の凹部31Aを利用して縦渦流（逆タンブル流）に生成し、この縦渦流を利用し

ながら、点火プラグ7近傍に燃料の噴霧を集めて安定した層状燃焼状態で運転を行なう超リーン運転モード（超リーン運転モード）と、吸気行程中に燃料を噴射し、燃焼室1内を略均一な混合気状態で予混合燃焼させて、燃料の希薄な状態で運転を行なうリーン運転モード（吸気リーン運転モード）と、空燃比が理論空燃比近傍となるように O_2 センサ情報等に基づいてフィードバック制御を行なうストイキオ運転モード（ストイキオフィードバック運転モード）と、燃料の過剰な状態（即ち、空燃比が理論空燃比よりも小）での運転を行なうエンジンリッチ運転モード（オープンループモード）とが設けられている。

そして、ECU20では、各センサからの検出情報に基づいて、エンジンの運転モードを設定するようになつており、アイドル時においては、冷却水温 T_w が低くなるにしたがい、一方、車両走行中においては、エンジン回転数 N_e 及び負荷状態を示す有効圧力 P_e が高くなるにしたがい、超リーン運転モード、吸気リーン運転モード、ストイキオフィードバック運転モード及びオープンループモードの順で、それぞれ選択されるようになっている。なお、有効圧力 P_e はエンジン回転数 N_e 及びアクセル開度 θ_a の各情報から算出されるものである。

【0018】なお、超リーン運転モード及びリーン運転モードでの運転をリーン運転といい、ストイキオ運転モードでの運転をストイキオ運転（理論空燃比運転）という。エンジン運転モードでの運転をリッチ運転と、エンジン運転モードでの運転をリーン運転とを併せて行なうように、図1とともに図2を参照しながら説明すると、触媒6の昇温要求があるとき（本実施形態では、触媒温度センサ3Aにより検出される触媒温度 T_{wc} が所定温度 T_{wco} よりも低いとき）には、運転状況に応じて排気弁4Aの可変動弁機構（排気弁作動可変手段）60Aとインジェクタ8との作動をECU20により制御して、触媒6の早期活性化を図るようになっている。

【0019】つまり、触媒温度 T_{wc} が所定温度 T_{wco} よりも低い場合には触媒6は十分な排気浄化機能を発揮することができないため、ECU20からの制御指令により、リッチ運転時にはストイキオ運転時には、第1のモードにより、サブ排気を行ない、リーン運転時には、第2のモードにより、追加燃料噴射及びサブ排気を行なうようになっている。これにより通常の排気行程中に排出される排ガスよりも高温の排ガスを排出させて、十分な排気浄化機能を発揮しうる活性化温度以上にまで触媒6を早期に昇温するようになっているのである。

【0020】なお、所定温度 T_{wco} は、制御遅れを考慮すると、活性化温度（触媒6の活性化領域の下限値）よりも所定の温度 α だけ高く設定することが望ましい。このため、ここでは所定温度 T_{wco} を活性化温度に所定温度 α を加えたものとしている（所定温度 $T_{wco} = \text{活性化$

内の混合気への点火を行なう。

【0026】混合気の燃焼により、燃焼室1内の温度は筒内の圧力とともに急激に上昇し、ピストン31の位置が上死点（TDC: Top Dead Center）をわずかに過ぎた所で最大（例えば、1000℃以上）となる。また、この燃焼に伴う燃焼室1内の圧力の上昇はエンジントルクとしてクランクシャフト5より出力される。そして、ピストン31が上死点を越えると、圧縮行程から膨張行程へと遷移する。この膨張行程における筒内圧の減少率にもよるが、図3中に⑤で示すように、燃焼室1内の温度は下降する。

【0027】触媒6を早期に活性化させるには、触媒6の中心温度を速やかに活性化温度（例えば、約570K）まで上昇させる必要がある。ところが、主燃焼により燃焼室1内の温度が高温に達したとしても、その後の膨張行程により燃焼ガスの温度は体積の膨張にともない徐々に低下していくので、このままでは、排気行程において高温の排ガスを触媒6に供給することはできず、触媒6の活性化を早期に行なうことができない。

【0028】そこで、本エンジンでは、触媒温度センサ3Aが検出した触媒温度 T_{wc} が所定温度 T_{wco} （所定温度 $T_{wco} = \text{活性化温度} + \text{所定の温度} \alpha$ ）よりも低く、且つ、リッチ運転又はストイキオ運転時には、ECU20の制御指令により、排気弁4Aの可変動弁機構60Aを動作させて、図3中に⑥で示すタイミミング及びカムプロフィールでサブ排気を行なうようにしている。

【0029】つまり、筒内の燃焼ガスの温度は膨張比の増加とともに低下していくため、排気行程よりも早期の膨張行程において排気弁4Aを開いて、高温のうちに燃焼ガスを排気通路3へ排出するようにしているのである。次に、リーン運転時に触媒6の早期活性化が必要なる場合に行なわれるサブ排気及び追加燃料噴射について説明する。

【0030】リーン運転時は、主燃料に対して等気量が過剰であるため、この過剰分の空気により膨張行程中に追加噴射される燃料を燃焼させて、燃焼ガスを昇温することが可能である。このため、本実施形態では、リーン運転時には、追加燃料噴射と併せてサブ排気を行なうことで、触媒6のさらなる早期活性化を行なえるようになっている。

【0031】つまり、図3中に⑦で示すタイミミング及びカムプロフィールにより実行されるサブ排気に先駆け、ECU20の制御指令により膨張行程前半でインジェクタ8により追加燃料噴射（膨張行程噴射）が行なわれるようになっている。そして、燃焼室1内へ直接噴射された追加燃料は、点火プラグ7で点火されるのではなく主燃焼の火炎伝播により着火され、主燃焼に比べて比較的低温で燃焼し、これにより図3中に⑧で示すように燃焼ガスが昇温するようになっている。そして、この昇温された燃焼ガスを、その後に行なわれるサブ排気によ

温度+所定の温度 α ）。ここで、追加燃料噴射とは、エンジントルクを発生させる主燃焼のための燃料噴射（主噴射）とは別に、筒内の燃焼ガスの高温化を目的として、膨張行程中にECU20からの制御指令に応じてインジェクタ8により行なわれるもので、追加噴射された燃料（追加燃料）は主燃焼の火炎伝播により着火されるようになっている。但し、主燃焼するのに必要な空気に加えて、追加燃料の燃焼（追加燃焼）用の空気が必要となるため、追加燃料噴射は、主燃焼に対して空気過剰の状態にあるリーン運転時にしか行なうことができない。

【0021】また、上述したように、サブ排気は、排気行程とは別に、膨張行程においても燃焼ガスの一部を筒内より排出するものである。つまり、膨張行程開始直前に点火プラグ7により着火されて急激に膨張する燃焼ガスはピストン31を押し下げてエンジントルクを発生させるが、この膨張に依りて燃焼ガスの温度は低下していく。そこで、排気行程時の筒内の燃焼ガスに比べて、膨張の度合い（膨張比）が低く温度の高い燃焼ガスを触媒6に供給すべく、膨張行程中に排気（サブ排気）を行なうようにしている。

【0022】なお、サブ排気が行なわれると、本来ならばピストン31を下死点まで押し下げるべき燃焼ガスが早期に筒内より排出されて、エンジントルクの低下が生じる。エンジンのアイドル時には、このようなエンジントルクの低下の改善は少ないが、車両走行中についてあるため、エンジントルクの低下を補う分を加算した値の燃焼が次の吸気行程又は圧縮行程で主噴射されるようになっている。

【0023】次に、サブ排気及び追加燃料噴射の制御について、図3とともに図2を参照しながら説明する。本実施形態では、触媒6の昇温（早期活性化）が必要な場合には、上述のように、リッチ運転又はストイキオ運転時にはサブ排気を行ない、リーン運転時にはサブ排気と追加燃料噴射とを併せて行なうようになっている。

【0024】まず、リッチ運転又はストイキオ運転時に、触媒6の早期活性化が必要な場合に行なわれるサブ排気について説明する。リッチ運転又はストイキオ運転時には、吸気行程中にECU20からインジェクタ8に燃料噴射信号が入力され、この間、インジェクタ8は、燃焼室1内に燃料を噴射するようにになっている。なお、この燃料噴射は主燃焼のための燃料噴射、即ち、主噴射である。

【0025】一方、圧縮行程中、燃焼室1内の混合気はクランクシャフト5の回転にともなうピストン31の上昇により圧縮され、燃焼室1内の温度（筒内温度）はピストン31による燃焼室1内の混合気の圧縮比に応じて上昇する。そして、インジェクタ8からの燃料噴射が終了した圧縮行程末期において、ECU20から点火プラグ7へ点火信号が入力され、点火プラグ7は、燃焼室1

11 出してから、さらに昇温させると判定されて、サブ排気を経由しながらリターンする。一方、触媒温度 T_{wco} が所定温度 T_{wco} 以上のときには、触媒6は十分に活性化されてこれ以上の昇温の必要はないと判定され、ステップS310へ進みサブ排気が停止される。

【0054】ところで、ステップS30で、冷却水温度 T_w が冷却水基準温度 T_{w0} 以上のときには、ステップS70で運転態様としてリターン運転が行われ、それに伴って燃料噴射（主噴射）の制御が行われ、ステップS80に進む。そして、ステップS80では、触媒温度 T_{wco} が所定温度 T_{wco} 以上のときには、触媒6は既に活性化されていると判定されて、それ以前にサブ排気が行なわれていたようにあればサブ排気が停止される（ステップS310）。一方、触媒温度 T_{wco} が所定温度 T_{wco} より低いときには、触媒6の昇温が必要であると判定されて、ステップS90で過型行程において追加燃料噴射が行われ、さらに、ステップS100で可変動弁用電磁弁を開弁駆動してエンジンの半数の気筒においてサブ排気を行ない、そしてステップS300へと進む。

【0055】一方、ステップS20で、アイドル検出信号Pが検出されずにエンジンがアイドル状態ではない、即ち車両走行中であると判定された場合には、エンジン回転数 N_e 及び負荷状態を示す有効圧力Pに応じて、運転モードが選択され（ステップS150）、これに応じた燃料噴射（主噴射）の制御が行なわれ（ステップS160）、ステップS170へ進む。

【0056】そして、ステップS170では、触媒温度 T_{wco} が所定温度 T_{wco} 以上のときには、触媒6の昇温は必要ないと判定されて、サブ排気が行なわれているように、触媒6が停止され（ステップS310）、一方、触媒温度 T_{wco} が所定温度 T_{wco} より低いときには、触媒6の昇温が必要であると判定されてステップS180へ進む。

【0057】そして、ステップS180では、サブ排気を行なう気筒については、このサブ排気によるエンジントルクの損失を補うべく、次の主噴射における燃料量の補正が行われ、その後、ステップS190に進み運転モードの遷移がリターン運転であるか否かの判定が行われる。そして、ステップS190で、リターン運転ではない、即ち、ストイキオ運転又はリッチ運転であると判定されると、ステップS200へと進み半数の気筒においてサブ排気が行なわれてステップS300へと進む。

一方、リターン運転であれば、半数の気筒において追加燃料噴射（ステップS210）及びサブ排気（ステップS220）が行われ、その後、やはりステップS300へと進む。

【0058】このように、本実施形態にかかる内燃機関の排気弁作動制御装置によれば、追加燃料噴射を行なうことのできるストイキオ運転時及びリッチ運転時において、サブ排気を行なうことにより、高温の排気ガスを排

12 出して触媒6を早期に昇温させて活性化させることができる。さらに、リターン運転時には、サブ排気と同時に追加燃料噴射を行なうことにより、サブ排気に加え、排気行程においても高温の排気ガスを排出することができ、より迅速に触媒6の活性化を行なうことができるという利点もある。

【0059】さらに、サブ排気は、排気行程とは独立して行なわれるので、排気行程における排気弁4Aの開弁時間に影響を及ぼすこともない。したがって、オーバーラップ（排気弁4Aと吸気弁4Bとが共に開いた状態）を減少させてしまうことがないので、エンジンの吸気効率の悪化を招くことがないという利点もある。また、通常の排気行程とは別に排気弁4Aを作動させることにより、触媒6の早期昇温に適した排気弁4Aの作動時間（開弁タイミング）と作動量（リフト量）とを設定できるので、触媒6の活性化を効率よく行なうことができるという利点もある。

【0060】そして、可変動弁機構60Aに作動油を供給するか否かにより、サブ排気を行なうが行なわれないかの切り換えが瞬時に行なえるため、こうした切り換え動作の応答性が良いという利点もある。なお、本発明の内燃機関の排気弁作動制御装置は、上述の実施形態に限定されるものではなく、種々変形して実施することができ

13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

【0061】例えば、上述の実施形態では、触媒6の早期活性化を行なうために、リッチ運転又はストイキオ運転時にはサブ排気を行ない、リターン運転時には追加燃料噴射とサブ排気とを行なうようにしているが、エンジンの運転態様に問わず触媒6の早期活性化手段としてサブ排気のみを行なうようにしてもよい。この場合、エンジンの半数の気筒についてのみ、排気弁に可変動弁機構をそなえてサブ排気を行なう構造とし、残りの半数については、排気弁に一般的な動弁機構をそなえた構造としてサブ排気は行なわないようにしてもよい。

【0062】さらに、可変動弁機構60Aを用いるかわりに、排気弁4Aを直進弁により構成して、排気弁4Aを任意のタイミングにより開閉可能な構造として、これによりサブ排気を行なうようにしてもよい。また、車両走行時にエンジントルクの損失が生じないように、サブ排気による触媒6の早期活性化をアイドル時にのみ行なうようにしてもよい。

【0063】そして、サブ排気を開始するタイミングを、膨張行程中期ではなく、点火プラグ7による点火直後（圧縮行程末期）としてもよい。この場合、燃焼中の高温のガスが排出されるため、より早期に触媒の昇温を行なうことができ、また、ピストン31が上死点にまで上昇する直前（圧縮行程末期）に、微量ながら燃焼ガスが排出されて圧力が逃がされるために、このタイミングにおいて上昇から下降へと切り換わるピストン31の動きによるエンジンの上下振動が低減されてこの振動による

騒音が抑制される。

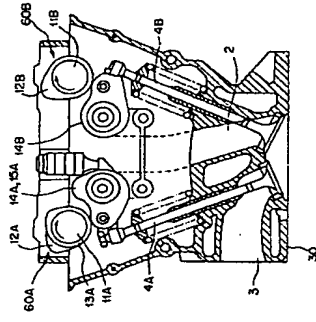
【0064】さらに、上述の実施形態では、簡内噴射型エンジンを用いた場合について説明してきたが、一般的なポート噴射型のエンジンに適用してもよい。ただし、一般的なポート噴射型のエンジンでは、吸気通路に噴射された燃料を吸気流を利用して燃焼室1内へ吸入するようになっているために、燃焼行程中の燃料噴射である追加燃料噴射を行なうことはできない。したがって、この場合、触媒6を昇温させる手段はサブ排気のみとなる。

【0065】（発明の効果）以上詳述したように、本発明の内燃機関の排気弁作動制御装置によれば、ストイキオ運転時又はリッチ運転時に、点火直後であって且つ膨張行程終了前に排気弁を一時的に開弁駆動させて排気（サブ排気）を行なうことにより高温の燃焼ガス（排気ガス）が排出されて排気浄化用触媒の早期活性化を行なうことができるという利点がある。

【0066】さらに、サブ排気にかかる排気弁の作動は、排気行程時の排気弁の作動とは別に行なわれるので、排気行程における排気弁の開弁時期に影響を及ぼすこともない。したがって、内燃機関の吸気効率の悪化を招くことがないという利点もある。また、通常の排気行程とは別に排気弁を作動させることにより、排気浄化用触媒の早期昇温に適した排気弁の作動時間（開弁タイミング）と作動量（リフト量）とを設定できるので、排気浄化用触媒の活性化を効率よく行なうことができるという利点もある。

【図面の簡単な説明】

【図4】



【図1】本発明の一実施形態としての内燃機関の排気弁作動制御装置における制御系の構成を模式的に示すブロック図である。

【図2】本発明の一実施形態としての内燃機関の排気弁作動制御装置における内燃機関の全体構成を示す模式図である。

【図3】本発明の一実施形態としての内燃機関の排気弁作動制御装置におけるカムプロファイル、点火信号のタイミング及び筒内温度とピストン位置との関係を示す図である。

【図4】本発明の一実施形態としての内燃機関の排気弁作動制御装置における排気弁作動可変手段及び吸気弁の動弁機構を模式的に示す構成図である。

【図5】本発明の一実施形態としての内燃機関の排気弁作動制御装置における排気弁作動可変手段の模式図であり、(A)は全体構成を示す斜視図、(B)は(A)のA-A矢視断面図でサブロッカアームがメインロッカアームと連係動作しない状態を示す図、(C)は(A)のA-A矢視断面図でサブロッカアームがメインロッカアームと連係動作する状態を示す図である。

【図6】本発明の一実施形態としての内燃機関の排気弁作動制御装置における制御を示すフローチャートである。

(符号の説明)

3 排気通路

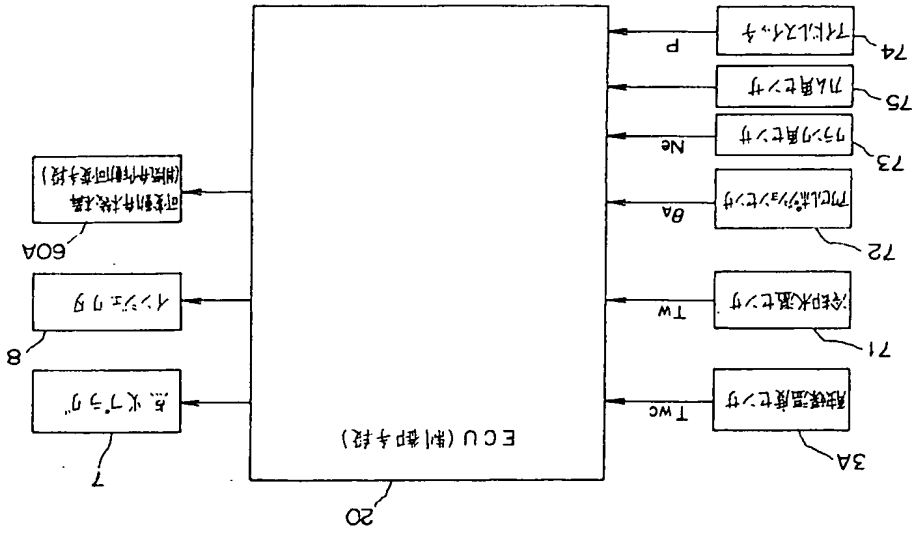
4 A 排気弁

6 排気浄化用触媒

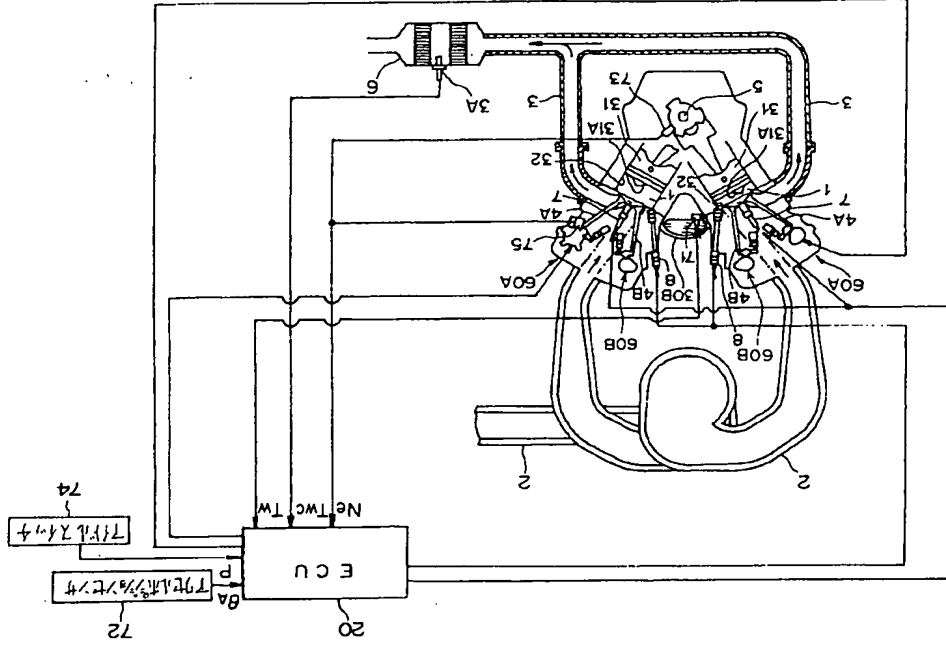
20 ECU (制御手段)

60 A 可変動弁機構 (排気弁作動可変手段)

【図1】



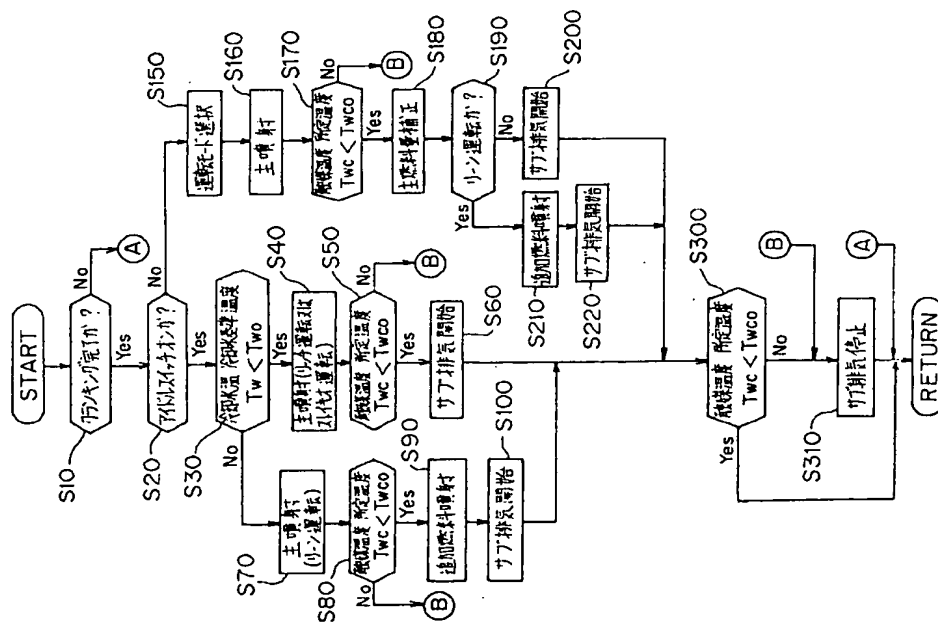
【図2】



フロントページの続き

Fターム(参考) 3G092 A01 A06 A09 A10 A11 A15 B06 B13 D02 D04 D12 D04 DF09 D05 E05 E06 E07 E08 E11 E26 E27 E01 F015 H009Z H002X H002Z H001Z H003Z H008Z H008Z

【例6】



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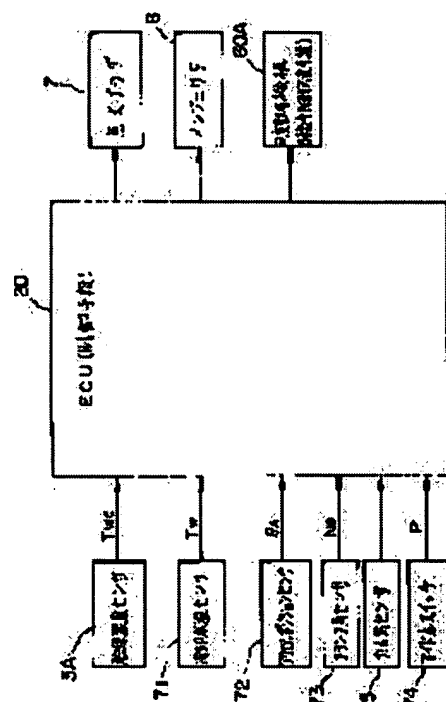
(72)Inventor : KUBO MASAHIKO

(54) EXHAUST VALVE OPERATION CONTROLLER FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To quickly increase the temperature of a catalyst to an activation temperature without causing any reductions in the intake efficiency of an engine in the exhaust valve operation controller of an internal combustion engine.

SOLUTION: When there is a request to increase the temperature of exhaust purifying catalyst, an exhaust valve operation varying means 60A is controlled by a control means 20, an exhaust valve is temporarily opened separately from the operation of the exhaust valve during an exhaust process after ignition and before the end of an expansion process, the exhaust gas of a temperature higher than that of exhaust gas during the exhaust process is discharged, and the temperature of the exhaust purifying catalyst is quickly increased to an activation temperature allowing a purifying function to be exhibited.



LEGAL STATUS

[Date of request for examination]

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[Kind of final disposal of application other than
the examiner's decision of rejection or
application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's
decision of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention is used for the vehicles which offered the catalyst for exhaust air purification, and relates to the suitable exhaust air valve-action control unit of an internal combustion engine.

[0002]

[Description of the Prior Art] The catalyst for exhaust air purification (catalytic converter for exhaust air purification) is prepared in the flueway that the injurious ingredient (nitrogen oxide) of HC (hydrocarbon), CO (carbon monoxide), NOX, etc. of non-** contained in the exhaust gas of engines, such as a gasoline engine, should be purified conventionally.

[0003] Since the catalyst for exhaust air purification (it is only henceforth called a catalyst) was not able to demonstrate sufficient exhaust air purification function unless temperature generally rises to a predetermined activity temperature field, it was a technical problem what the temperature up of the catalyst is carried out at an early stage to an activity temperature field. By carrying out the tooth lead angle of the phase of an exhaust cam to JP,5-96444,U from the usual position, and opening an exhaust valve at an early stage there, hot combustion gas is discharged and the technology which attained early activation of a catalyst by this exhaust gas is proposed.

[0004]

[Problem(s) to be Solved by the Invention] However, if inhalation-of-air efficiency is taken into consideration in order to make an exhaust valve closed at an early stage and to decrease overlap (state which both the exhaust valve and the inlet valve opened), when carrying out the tooth lead angle of the phase of an exhaust cam as mentioned above, a limitation will produce naturally the amount of tooth lead angles of the phase of an exhaust cam.

[0005] Therefore, with above-mentioned technology, hot exhaust gas cannot fully be supplied to a catalyst, but the problem that a catalyst requires time for reaching an activation temperature arises. moreover -- between the phase of usually exhaust air with above-mentioned technology, and the phases of early exhaust air -- drivability -- taking into consideration -- a phase change -- gradually -- **** -- since it cannot carry out, the responsibility of operation change control of an exhaust valve will be bad, and will become the cause by which a catalyst can carry out activity also of this point at an early stage, and there is in it [no]

[0006] It was originated in view of such a technical problem, and this invention aims at offering the exhaust air valve-action control unit of an internal combustion engine it enabled it to raise the temperature of a catalyst to an activation temperature promptly, without causing aggravation of the inhalation-of-air efficiency of an engine.

[0007]

[Means for Solving the Problem] for this reason, in the exhaust air valve-action control unit of the internal combustion engine of this invention according to claim 1 When there is a temperature up demand of the catalyst for exhaust air purification, an exhaust air valve-action adjustable means is

controlled by control means. Apart from [an exhaust air line] the operation of the exhaust valve at the time, it is after ignition and the valve-opening operation of the exhaust valve is temporarily carried out before an expansion-stroke end, an exhaust air line discharges hot exhaust air rather than the exhaust air at the time, and the temperature up of the catalyst for exhaust air purification is made to carry out at an early stage even to the activation temperature which can demonstrate a purification function.

[0008]

[Embodiments of the Invention] Hereafter, it explains, referring to drawing 1 - drawing 6 about the exhaust air valve-action control unit of the internal combustion engine as 1 operation gestalt of this invention. As it is the four stroke cycle engine offered into a 1 operation cycle and each distance of inhalation of air, compression, expansion, and exhaust air is shown in drawing 2 , the engine in this operation gestalt is constituted as a cylinder-injection-of-fuel type internal combustion engine (cylinder-injection-of-fuel type gasoline engine) which injects direct fuel and is burned by jump spark ignition in a cylinder, and is constituted as a cylinder-injection-of-fuel type gasoline engine of a V type especially here.

[0009] And the inhalation-of-air path 2 and a flueway 3 are connected to a combustion chamber 1, and free passage control of the inhalation-of-air path 2 and the flueway 3 is carried out by inlet-valve 4B and exhaust valve 4A in a combustion chamber 1, respectively. Moreover, the catalyst 6 for exhaust air purification (it is only henceforth called a catalyst) which the air cleaner and throttle valve which are not illustrated are prepared in the inhalation-of-air path 2, and removes the injurious ingredient in exhaust gas in a flueway 3 and the muffler which is not illustrated (silencer) It is prepared.

[0010] Moreover, 8 is an injector (fuel injection valve), and that fuel should be injected directly towards the combustion chamber 1 in a cylinder 32, it is arranged so that a combustion chamber 1 may be made to face the opening. Moreover, as for an injector 8, the operation is controlled based on the signal from the electronic control unit (ECU) 20 as control means. Here, good change valve-system (VVT) 60A as an exhaust air valve-action adjustable means whose switch of the operating state (valve-opening timing and the amount of lifts) of exhaust valve 4A is enabled is offered on exhaust valve 4A. On the other hand, valve gear 60B which always carries out the valve-opening drive of the inlet-valve 4B to fixed timing is offered on inlet-valve 4B.

[0011] And by switching and controlling the operating state of this good change valve-system 60A Usually, in addition to the valve-opening drive like an exhaust air line performed, are after ignition and the valve-opening drive of the exhaust valve 4A is carried out before an expansion-stroke end (here inside of an expansion stroke). Thereby, rather than the time, hot exhaust gas can be discharged by the flueway 3, and an exhaust air line can raise the temperature of a catalyst 6, and can perform early activation now. Henceforth, the exhaust air in such an expansion stroke is called sub exhaust air.

[0012] In addition, as the mode in which sub exhaust air is performed, there are two kinds in the mode (the 1st mode) in which sub exhaust air is performed independently, and the mode (the 2nd mode) in which sub exhaust air is performed with additional fuel injection, and each of these modes are switched according to the operation mode of an engine so that it may mention later. And among all the cylinders offered on an engine, it can be constituted from this operation gestalt by the half cylinder so that only 1st mode can be performed, and only the 2nd mode can be performed now about the cylinder of the remaining moieties.

[0013] Moreover, the timing which was suitable for performing sub exhaust air in the 1st mode and 2nd mode differs slightly, and it is constituted from good change valve-system 60A of a cylinder which can perform the 1st mode, and good change valve-system 60A which can perform the 2nd mode by this operation gestalt so that the properties may differ so that sub exhaust air may be performed to suitable timing in each mode.

[0014] Moreover, the 1st mode and the 2nd mode are constituted so that only one of the modes may be performed alternatively. It becomes only the cylinder of the moiety of an engine to perform sub exhaust air by this, and the rapid fall of an engine torque is prevented. That is, it is made for the rapid fall of an engine torque not to produce performing sub exhaust air, when leading to loss of an engine torque, therefore performing the temperature up of a catalyst 6, since discharging exhaust gas in an expansion

stroke is making the combustion gas which depresses the piston 31 in a cylinder and is made to generate an engine torque discharge at an early stage only as a cylinder of the moiety of an engine.

[0015] In addition, about good change valve-system 60A and valve gear 60B, it mentions later. By the way, as shown in drawing 1 and drawing 2, the various sensors of degree sensor of catalyst temperature 3A, the cooling coolant temperature sensor 71, the accelerator position sensor (APS) 72, the crank angle sensor 73, an idle switch 74, and cam angle sensor 75 grade are formed in this engine, and the detecting signal from each sensor is sent to ECU20.

[0016] Degree sensor of catalyst temperature 3A is prepared in the catalyst 6, and detects the temperature TWC within a catalyst 6 (the degree of catalyst temperature). Moreover, it is inserted in water-jacket 30B prepared in the cylinder block between a right bank and a left bank, and the cooling coolant temperature sensor 71 is the cooling water temperature TW of an engine. It detects. Moreover, the accelerator position sensor 72 is accelerator opening θ_A as an engine load. It detects. And the crank angle sensor 73 is formed in a crankshaft 5, and detects an engine speed N_e . Moreover, an idle switch 74 outputs the idle detecting signal P at the time of an idle state.

[0017] Moreover, injecting fuel in a compression stroke, generating the inhalation-of-air style which flowed in the combustion chamber 1 in the style of a longitudinal vortex (reverse tumble flow) as the operation mode, with this engine, using crevice 31A of piston 31 top face, and using this longitudinal vortex style The super-RIN operation mode which operates in the state of the stratified combustion which brought spraying of fuel together in about seven ignition plug, and was stabilized in it (compression RIN operation mode), the inside of an intake stroke -- fuel -- injecting -- the inside of a combustion chamber 1 -- abbreviation -- a uniform gaseous mixture -- with the RIN operation mode (inhalation-of-air RIN operation mode) which is made to carry out a premixed combustion in the state, and operates in the thin state of fuel The strike IKIO operation mode which performs feedback control based on O₂ sensor information etc. so that an air-fuel ratio may become near the theoretical air fuel ratio (strike IKIO feedback operation mode), The enrichment operation mode (open loop mode) which performs operation in the ***** state (that is, an air-fuel ratio theoretical air fuel ratio smallness) of fuel is prepared. And in ECU20, based on the detection information from each sensor, set up the operation mode of an engine and it sets at the time of an idle. Cooling water temperature TW On the other hand, it sets during a vehicles run as it becomes low. It is chosen in order of compression RIN operation mode, inhalation-of-air RIN operation mode, strike IKIO feedback operation mode, and an open loop mode, respectively as the effective pressure P_e which shows an engine speed N_e and loaded condition becomes high. In addition, an effective pressure P_e is an engine speed N_e and accelerator opening θ_A . It is computed from each information.

[0018] In addition, operation by super-RIN operation mode and RIN operation mode is called RIN operation, operation by strike IKIO operation mode is called strike IKIO operation (theoretical-air-fuel-ratio operation), and operation by enrichment operation mode is called rich operation. Next, when the important section function of this invention is explained referring to drawing 2 with drawing 1 and there is a temperature up demand of a catalyst 6 (with this operation gestalt) The degree TWC of catalyst temperature detected by degree sensor of catalyst temperature 3A is the predetermined temperature TWC0. At the time of a low According to an operation situation, an operation with good change valve-system (exhaust air valve-action adjustable means) 60A and the injector 8 of exhaust valve 4A is controlled by ECU20, and early activation of a catalyst 6 is attained.

[0019] That is, the degree TWC of catalyst temperature is the predetermined temperature TWC0. Since a catalyst 6 cannot demonstrate sufficient exhaust air purification function to a low case, at the time of rich operation or strike IKIO operation, the 1st mode performs only sub exhaust air by the control command from ECU20, and the 2nd mode performs additional fuel injection and sub exhaust air at the time of RIN operation. Thereby, hot exhaust gas is made to discharge rather than the exhaust gas by which the more usual exhaust air line is discharged in inside, and the temperature up of the catalyst 6 is carried out at an early stage even more than the activation temperature which can demonstrate sufficient exhaust air purification function.

[0020] In addition, predetermined temperature TWC0 When control delay is taken into consideration, it

is more desirable than an activation temperature (lower limit of the activation field of a catalyst 6) to set up only the predetermined temperature alpha highly. For this reason, it is the predetermined temperature TWC0 here. The predetermined temperature alpha should be applied to the activation temperature (predetermined temperature TWC0 = activation-temperature + predetermined temperature alpha). Here, independently [additional fuel injection], fuel injection for the main combustion which generates an engine torque (main injection) is performed by the injector 8 according to the control command from ECU20 into an expansion stroke for the purpose of elevated-temperature-izing of the combustion gas in a cylinder, and the fuel (additional fuel) by which additional injection was carried out is lit by the flame propagation of the main combustion. However, since the air for combustion (additional combustion) of additional fuel is needed in addition to air required to main-burn, additional fuel injection can be performed only at the time of RIN operation which is in the state of the excess of air to a main fuel. [0021] Moreover, as mentioned above, sub exhaust air discharges a part of combustion gas from the inside of a cylinder also in an expansion stroke as independently as an exhaust air line. That is, although the combustion gas for which an ignition plug 7 is lit just before an expansion-stroke start and which expands rapidly depresses a piston 31 and an engine torque is generated, the temperature of combustion gas falls according to this expansion. Then, the exhaust air line is made to exhaust in an expansion stroke compared with the combustion gas in the cylinder at the time that combustion gas with high temperature with the low degree (expansion ratio) of expansion should be supplied to a catalyst 6 (sub exhaust air).

[0022] In addition, when sub exhaust air is performed, properly speaking, the combustion gas which should depress a piston 31 to a bottom dead point is discharged from the inside of a cylinder at an early stage, and the fall of an engine torque arises. At the time of the idle of an engine, although there is little influence of a fall of such an engine torque, since the fall of this engine torque becomes what cannot be disregarded, about under a vehicles run, the main injection of the fuel of the amount adding the part with which the fall of an engine torque is compensated is carried out by a next intake stroke or a next compression stroke.

[0023] Next, control of sub exhaust air and additional fuel injection is explained, referring to drawing 2 with drawing 3 . With this operation gestalt, when the temperature up (early activation) of a catalyst 6 is required, as mentioned above, sub exhaust air is performed at the time of rich operation or strike IKIO operation, and at the time of RIN operation, sub exhaust air and additional fuel injection are combined, and are performed.

[0024] First, the sub exhaust air performed at the time of rich operation or strike IKIO operation when a catalyst 6 needs to be early activated is explained. At the time of rich operation or strike IKIO operation, a fuel-injection signal is inputted into an injector 8 from ECU20 into an intake stroke, and an injector 8 injects fuel in a combustion chamber 1 in the meantime. In addition, this fuel injection is the fuel injection for the main combustion, i.e., the main injection.

[0025] On the other hand, the gaseous mixture in a compression stroke and in a combustion chamber 1 is compressed by elevation of the piston 31 accompanying rotation of a crankshaft 5, and the temperature in a combustion chamber 1 (temperature in a cylinder) rises according to the compression ratio of the gaseous mixture in the combustion chamber 1 with a piston 31. And in the compression stroke last stage which the fuel injection from an injector 8 ended, an ignition signal is inputted into an ignition plug 7 from ECU20, and an ignition plug 7 performs ignition to the gaseous mixture in a combustion chamber 1.

[0026] By combustion of a gaseous mixture, the temperature in a combustion chamber 1 rises rapidly with the pressure in a cylinder, and serves as the maximum (for example, 1000 degrees C or more) in the place where the position of a piston 31 passed the top dead center (TDC:Top Dead Center) slightly. Moreover, elevation of the pressure in the combustion chamber 1 accompanying this combustion is outputted from a crankshaft 5 as an engine torque. And with reduction of the cylinder internal pressure in this expansion stroke, if a piston 31 crosses a top dead center, although it will change from a compression stroke to an expansion stroke, as ** shows in drawing 3 , the temperature in a combustion chamber 1 descends.

[0027] In order to activate a catalyst 6 at an early stage, it is necessary to raise the main temperature of a catalyst 6 to an activation temperature (for example, about 570 K) promptly. However, though the temperature in a combustion chamber 1 reaches an elevated temperature by the main combustion, since the temperature of combustion gas falls gradually with expansion of volume by the subsequent expansion stroke, with this, it can set like an exhaust air line, hot exhaust gas cannot be supplied to a catalyst 6, and a catalyst 6 cannot be activated at an early stage.

[0028] Then, the degree TWC of catalyst temperature which degree sensor of catalyst temperature 3A detected with this engine is lower than the predetermined temperature TWC0 (predetermined temperature $TWC0 = \text{activation-temperature} + \text{predetermined temperature } \alpha$). And at the time of rich operation or strike IKIO operation, good change valve-system 60 of exhaust valve 4A is operated, and it is made to perform sub exhaust air by the control command of ECU20 by the timing and the cam profile which are shown by ** in drawing 3 .

[0029] That is, since the temperature of the combustion gas in a cylinder falls with the increase in an expansion ratio, an exhaust air line opens exhaust valve 4A in an early expansion stroke, and it is made to discharge [a line] combustion gas also for a twist to a flueway 3 to the inside of an elevated temperature. Next, the sub exhaust air and the additional fuel injection which are performed at the time of RIN operation when a catalyst 6 needs to be early activated are explained.

[0030] At the time of RIN operation, it is possible to burn the fuel in which additional injection is carried out into an expansion stroke by the air for this excess, and to carry out the temperature up of the combustion gas to a main fuel, since the air content is superfluous. For this reason, it is combining with additional fuel injection and performing sub exhaust air, and enables it to perform further early activation of a catalyst 6 about the time of RIN operation with this operation gestalt.

[0031] That is, the initiative is taken in the sub exhaust air performed by the timing and the cam profile which are shown by ** in drawing 3 , and additional fuel injection (expansion-stroke injection) is performed by the control command of ECU20 with an injector 8 in the first half of an expansion stroke. And the additional fuel injected directly into the combustion chamber 1 is lit by the flame propagation of the main combustion rather than is lit with an ignition plug 7, and burns at low temperature comparatively compared with the main combustion, and as this shows by ** in drawing 3 , combustion gas carries out a temperature up. And while making a flueway 3 discharge this combustion gas by which the temperature up was carried out in an expansion stroke by the sub exhaust air performed after that, also set it like an exhaust air line, and hot exhaust gas is made to discharge, and the early temperature up of a catalyst 6 has come be made.

[0032] In addition, since it is desirable to perform sub exhaust air after additional fuel injection when performing sub exhaust air with additional fuel injection in this way, the timing of a sub exhaust air start is late rather than the case where only sub exhaust air is performed without performing additional fuel injection. Moreover, the energy generated by combustion of additional fuel is chiefly used for the temperature rise in a combustion chamber 1, without being changed into elevation of the pressure in a combustion chamber 1. Therefore, an engine torque is not changed with this additional fuel.

[0033] Next, good change valve-system 60A and valve gear 60B are explained. As mentioned above, about exhaust valve 4A, good change valve-system 60A is offered, valve gear 60B is offered about inlet-valve 4B, respectively, and good change valve-system 60A consists of these operation gestalten like what was indicated by the publication-number No. 33719 [six to] official report, for example so that it might mention later.

[0034] Specifically, as shown in drawing 4 and drawing 5 (A), good change valve-system 60 of exhaust valve 4A offers the cams 12A and 13A prepared in cam-shaft 11A which rotates corresponding to rotation of the crankshaft 5 (refer to drawing 2) of an engine, and the rocker arms 14A and 15A driven by these cams 12A and 13A, and is constituted.

[0035] Cam 12A is a main cam which carries out the valve-opening drive of the exhaust valve 4A to carry out like the usual exhaust air line here, and, on the other hand, for cam 13A, the temperature TWC within a catalyst 6 (refer to drawing 2) is the predetermined temperature TWC0. In order to perform early activation of a catalyst 6 only within the time of a low, it is the sub cam which can carry out the

valve-opening drive of the exhaust valve 4A into an expansion stroke. Moreover, rocker-arm 14A is a main rocker arm driven by main cam 12A, and rocker-arm 15A is a sub rocker arm driven by sub cam 13A.

[0036] On the other hand, valve gear 60 of inlet-valve 4B is the thing of a mechanism without the part which accompanies a sub cam, a sub rocker arm, and them to good change valve-system 60A, as shown in drawing 4. That is, cam 12B which carries out the valve-opening drive of the inlet-valve 4B to perform an intake stroke, and rocker-arm 14B driven by this cam 12B are offered, and cam 12B is prepared in cam-shaft 11B which is interlocked with rotation of the crankshaft 5 of an engine and rotates. Thereby, the valve-opening drive of the inlet-valve 4B is depressed that is, carried out through rocker-arm 14B by cam 12B which is interlocked with a crankshaft 5 and rotates in a predetermined rotation position.

[0037] Here exhaust valve 4A and inlet-valve 4B of this operation gestalt It is set up so that it may become the cam profile shown in drawing 3. the phase contrast of main cam 12 of exhaust valve 4A A, and cam 12 of inlet-valve 4B B For example, in a crank angle, it is set as about 210 degrees (it sets on a cam square and is about 105 degrees), and main cam 12 of exhaust valve 4A A and sub cam 13A are attached so that it may have predetermined phase contrast $\Delta\theta$ (refer to drawing 3) in a crank angle.

[0038] Moreover, as mentioned above, about a moiety, sub exhaust air can be performed among the cylinders offered on an engine at the time of rich operation or strike IKIO operation, and sub exhaust air can be performed with additional fuel injection about the remaining moieties at the time of RIN operation. For this reason, as shown in drawing 3, the timing which performs sub exhaust air for every cylinder of these moieties differs. Therefore, by sub cam 13A installed in the cylinder which can perform sub exhaust air at the time of rich operation or strike IKIO operation, and sub cam 13A installed in the cylinder which can perform sub exhaust air with additional fuel injection at the time of RIN operation, above-mentioned phase contrast $\Delta\theta$ also differs with some, and is set up.

[0039] Moreover, the maximum lift LS of sub cam 13A And period (valve-opening period) θ_S carries out the valve-opening drive of the exhaust valve 4A The maximum lift LM of main cam 12A And valve-opening period θ_M It is set up so that it may compare and may become small, and whether the valve-opening drive of the exhaust valve 4A is carried out by sub cam 13A or sub exhaust air is performed that is, a part of combustion gas in a cylinder is discharged by the flueway 3.

[0040] In addition, in drawing 3, the lift of sub cam 13A is exaggerated and shown, and becomes a thing smaller than what was illustrated in fact. Drawing 5 (A), (B), and (C) explain good change valve-system 60A to a detail further. It becomes 2 pairs and exhaust valve 4A is offered, as shown in drawing 5 (A), and good change valve-system 60A which drives exhaust valves 4A and 4A has offered the cams 12A and 13A prepared in cam-shaft 11A as mentioned above, and the rocker arms 14A and 15A driven by these cams 12A and 13A.

[0041] Rocker arms 14A and 15A are all rocker arms with a roller, rocker-arm 14A is a main rocker arm directly concerning the opening-and-closing drive of these exhaust valves 4A and 4A in contact with exhaust valves 4A and 4A, and rocker-arm 15A is a sub rocker arm indirectly involved in the opening-and-closing drive of these exhaust valves 4A and 4A, without contacting exhaust valves 4A and 4A.

[0042] Main rocker-arm 14A is prepared in the rocker shaft 16 at one, as shown in drawing 5 (B) and (C). This rocker shaft 16 is supported pivotably by bearing 30A prepared in the cylinder head 30 (refer to drawing 4) of an engine etc., and main rocker-arm 14A can circle now in it focusing on a rocker shaft 16.

[0043] The main roller 18 which may contact main cam 12A is offered on the pars intermedia of main rocker-arm 14A. This main roller 18 is supported pivotably by shaft 18A supported to revolve by the pars intermedia of main rocker-arm 14A, and may have comes to rotate smoothly. According to such structure, rotating with cam-shaft 11A, main cam 12A contacts the main roller 18 in a predetermined rotation position, and carries out the valve-opening drive of the exhaust valves 4A and 4A periodically through main rocker-arm 14A.

[0044] On the other hand, in the tubed base 62, sub rocker-arm 15A is supported to revolve so that it can

rotate to a rocker shaft 16 (getting it blocked main rocker-arm 14A), and it has offered the sub roller 19 which may contact the rocking edge 61 at sub cam 13A. This sub roller 19 is also supported pivotably by shaft 19A supported to revolve by the rocking edge 61 of sub rocker-arm 15A, and may have comes to rotate smoothly.

[0045] Between this sub rocker-arm 15A and rocker shaft 16, the oil pressure piston mechanism 17 is established as mode means for switching which can switch the mode (mode in which it does not coordinate) which sub rocker-arm 15A can be rotated and does not carry out coordinated operation with main rocker-arm 14A to a rocker shaft 16, and the mode (coordinated mode) which sub rocker-arm 15A a rocker shaft 16 and really rotates, and carries out coordinated operation with main rocker-arm 14A.

[0046] The oil pressure piston mechanism 17 as these mode means for switching has offered piston 17A arranged in the piston interior of a room formed in the rocker shaft 16 movable in the diameter direction of a rocker shaft 16, as shown in drawing 5 (B) and (C). And if a hydraulic oil is drawn from oilway 16A formed in the axial center portion of a rocker shaft 16, as shown in drawing 5 (C) Piston 17A drives to upper part] in point side [drawing 5 (B) and (C), and on the other hand, if supply of a hydraulic oil is severed, as shown in drawing 5 (B), piston 17A will drive to lower part] in end face section side [drawing 5 (B) and (C).

[0047] When a hydraulic oil is supplied, that is, by movement to the point of piston 17A If it becomes the mode (coordinated mode) which sub rocker-arm 15A a rocker shaft 16 and really rotates, and carries out coordinated operation with main rocker-arm 14A and [referring to drawing 5 (C)] and supply of a hydraulic oil are severed [refer to drawing 5 (B)] -- it is set up like [which serves as the mode (mode in which it does not coordinate) which the sub rocker arm 15 can be rotated and does not carry out coordinated operation with main rocker-arm 14A to a rocker shaft 16 by secession from the point of piston 17A]

[0048] Moreover, supply of a hydraulic oil is performed through the hydraulic-oil supply system which is not illustrated through oilway 16A in a rocker shaft 16. And the supply state which supplies a hydraulic oil, and the supply interruption state which is not supplied switch the solenoid valve (it is henceforth called the solenoid valve for good change valves) prepared in the hydraulic-oil supply system by carrying out opening-and-closing control by ECU20.

[0049] And with this operation gestalt, it can switch now whether the sub exhaust air for catalytic-activity-izing is performed by controlling this solenoid valve for good change valves, and switching an operation and un-operating according to the degree TWC of catalyst temperature from degree sensor of catalyst temperature 3A. [of exhaust valve 4A by sub cam 13A] Since the engine concerning 1 operation gestalt of this invention is constituted as mentioned above, according to a flow chart as shown, for example in drawing 6 , control is performed periodically, and an operation mode is switched.

[0050] First, the judgment of whether cranking was completed by the engine speed Ne inputted by Step S10 from the crank angle sensor 73 or the cam angle sensor 75 is performed. In an engine, combustion is already started, if an engine speed Ne is higher than a predetermined rotational frequency, it will be judged with having completed cranking and will progress to Step S20, and on the other hand, if an engine speed Ne is below a predetermined rotational frequency, it will judge that cranking has not completed and it will carry out a return.

[0051] And by an engine's not being an idle state, if it is judged for an engine by the idle switch 74 whether it is an idle state and the idle detecting signal P is not detected at Step S20, i.e., being judged with vehicles being under run and progressing to Step S150, if the idle detecting signal P is detected on the other hand, an engine will be judged to be an idle state, and it progresses to Step S30.

[0052] And cooling water temperature TW inputted from the cooling coolant temperature sensor 71 at Step S30 It responds, operation mode is chosen and it is the cooling water temperature TW. Rather than the cooling water reference temperature TW0, at the time of a low, rich operation or strike IKIO operation is chosen, control of the fuel injection (main injection) according to it is performed (Step S40), and it progresses to Step S50. And at Step S50, whether the catalyst 6 is activated It judges with the degree TWC of catalyst temperature inputted from degree sensor of catalyst temperature 3A, and the degree TWC of catalyst temperature is the predetermined temperature TWC0. It is judged with it already

being activated and a catalyst 6 not having the need for a temperature up, when it is above. If sub exhaust air is performed before it, the solenoid valve for good change valves is closed, it will be stopped (Step S310) and sub exhaust air will carry out a return. On the other hand, the degree TWC of catalyst temperature is the predetermined temperature TWC0. At the time of a low It is not activated but a catalyst 6 carries out the valve-opening drive of the solenoid valve for good change valves that it is judged with the ability of sufficient exhaust air purification function not to be demonstrated, and the temperature up of the catalyst 6 should be promptly carried out by hot exhaust gas rather than the exhaust gas discharged like the usual exhaust air line. Sub exhaust air is performed in the cylinder of the moiety of an engine (Step S60), and it progresses to Step S300.

[0053] And at Step S300, it judges whether the temperature up of the catalyst 6 was fully carried out, and the degree TWC of catalyst temperature is the predetermined temperature TWC0. At the time of a low, it is not yet activated, but a catalyst 6 is judged as there being the need for a temperature up further, and the return of it is carried out, continuing sub exhaust air. On the other hand, the degree TWC of catalyst temperature is the predetermined temperature TWC0. When it is above, it is fully activated, and the need for the above temperature up is judged as there being nothing, a catalyst 6 progresses to Step S310, and sub exhaust air is stopped.

[0054] By the way, it is the cooling water temperature TW at Step S30. When it is zero or more cooling water reference temperature TW, RIN operation is chosen as an operation mode at Step S70, control of the fuel injection (main injection) according to it is performed, and it progresses to Step S80. And at Step S80, the degree TWC of catalyst temperature is the predetermined temperature TWC0. When it is above, it is judged with the catalyst 6 already being activated, and if it seems that sub exhaust air is performed before it, sub exhaust air will be stopped (Step S310). On the other hand, the degree TWC of catalyst temperature is the predetermined temperature TWC0. At the time of a low, it is judged with the temperature up of a catalyst 6 being required, and additional fuel injection is performed in an expansion stroke at Step S90, further, the valve-opening drive of the solenoid valve for good change valves is carried out at Step S100, and sub exhaust air is performed in the cylinder of the moiety of an engine, and it progresses to Step S300.

[0055] On the other hand, at Step S20, when an engine was not an idle state, i.e., it is judged with it vehicles being under run, without detecting the idle detecting signal P, according to the effective pressure P_e which shows an engine speed N_e and loaded condition, operation mode is chosen (Step S150), control of the fuel injection (main injection) according to this is performed (Step S160), and it progresses to Step S170.

[0056] And at Step S170, the degree TWC of catalyst temperature is the predetermined temperature TWC0. If it seems that it is judged with the temperature up of a catalyst 6 being unnecessary, and sub exhaust air is performed when it is above, sub exhaust air will be stopped (Step S310), and on the other hand, the degree TWC of catalyst temperature is the predetermined temperature TWC0. At the time of a low, it is judged with the temperature up of a catalyst 6 being required, and progresses to Step S180.

[0057] And at Step S180, about the cylinder which performs sub exhaust air, amendment of the fuel quantity in the next main injection is performed, after that, it progresses to Step S190 and the judgment of whether the mode of operation mode is RIN operation is performed to compensate loss of the engine torque by this sub exhaust air. And at Step S190, if it is not RIN operation, i.e., judged with their being strike IKIO operation or rich operation, it progresses to Step S200, and sub exhaust air will be performed in a half cylinder, and it will progress to Step S300. On the other hand, if it is RIN operation, in a half cylinder, additional fuel injection (Step S210) and sub exhaust air (Step S220) will be performed, and it will progress to Step S300 too after that.

[0058] Thus, according to the exhaust air valve-action control unit of the internal combustion engine concerning this operation gestalt, by performing sub exhaust air at the time of strike IKIO operation which cannot perform additional fuel injection, and rich operation, hot exhaust gas is discharged, the temperature up of the catalyst 6 can be carried out at an early stage, and it can be activated. Furthermore, at the time of RIN operation, by performing additional fuel injection simultaneously with sub exhaust air, in addition to sub exhaust air, it can also set like an exhaust air line, hot exhaust gas can be

discharged, and there is also an advantage that a catalyst 6 can be activated more quickly.

[0059] Furthermore, since sub exhaust air is performed independently like an exhaust air line, influence is not done at the valve-opening stage of exhaust valve 4A which can be set like an exhaust air line. Therefore, since overlap (state which both exhaust valve 4A and inlet-valve 4B opened) is not decreased, there is also an advantage of not causing aggravation of the inhalation-of-air efficiency of an engine. Moreover, since the operation stage (valve-opening timing) and the amount of operations (the amount of lifts) of exhaust valve 4A which was suitable for the early temperature up of a catalyst 6 by operating exhaust valve 4A as independently as the usual exhaust air line can be set up, there is also an advantage that a catalyst 6 is efficiently activable.

[0060] And since a switch of whether sub exhaust air is performed or not to carry out can carry out in an instant by whether a hydraulic oil is supplied to good change valve-system 60A, the advantage of being good also has the responsibility of such switch operation. In addition, the exhaust air valve-action control unit of the internal combustion engine of this invention is not limited to an above-mentioned operation gestalt, can deform variously and can be carried out.

[0061] For example, although sub exhaust air is performed at the time of rich operation or strike IKIO operation and it is made to perform additional fuel injection and sub exhaust air with the above-mentioned operation gestalt at the time of RIN operation in order to perform early activation of a catalyst 6, it is not concerned with the operation mode of an engine, but may be made to perform only sub exhaust air as an early activation means of a catalyst 6. In this case, it considers as the structure where a good change valve system is offered on an exhaust valve, and sub exhaust air can be performed only about the cylinder of the moiety of an engine, and may not be made not to perform sub exhaust air as structure which offered the valve gear general to an exhaust valve about the remaining moieties.

[0062] Furthermore, a solenoid valve constitutes exhaust valve 4A, and you may enable it to perform sub exhaust air for exhaust valve 4A thereby as structure which can be opened and closed by arbitrary timing instead of using good change valve-system 60A. Moreover, you may be made to perform early activation of the catalyst 6 by sub exhaust air only at the time of an idle so that loss of an engine torque may not arise at the time of a vehicles run.

[0063] And it is good also as immediately after ignition according the timing which starts sub exhaust air not to the middle of an expansion stroke but to the ignition plug 7 (compression stroke last stage). since [in this case,] combustion gas is discharged with a minute amount and a pressure is missed, just before it can perform the temperature up of a catalyst at an early stage more and a piston 31 goes up even to a top dead center (compression stroke last stage), since the hot gas under combustion is discharged -- this timing **** -- the vertical vibration of the engine by the movement of the piston 31 which switches from elevation to descent is reduced, and the noise by this vibration is suppressed

[0064] Furthermore, although the above-mentioned operation gestalt has explained the case where a cylinder-injection-of-fuel type engine is applied, you may apply to general port injection type ENNJIN. However, in general port injection type ENNJIN, in order to inhale the fuel injected by the inhalation-of-air path into a combustion chamber 1 using an inhalation-of-air style, additional fuel injection which is the fuel injection in a compression stroke cannot be performed. Therefore, the means to which the temperature up of the catalyst 6 is carried out in this case serves as only sub exhaust air.

[0065]

[Effect of the Invention] As explained in full detail above, according to the exhaust air valve-action control unit of the internal combustion engine of this invention, there is an advantage that hot combustion gas (exhaust gas) is discharged and early activation of the catalyst for exhaust air purification can be performed, by exhausting by being after ignition and carrying out the valve-opening operation of the exhaust valve temporarily before an expansion-stroke end at the time of strike IKIO operation or rich operation (sub exhaust air).

[0066] Furthermore, since the operation of the exhaust valve concerning sub exhaust air is performed by the exhaust air line apart from the operation of the exhaust valve at the time, influence is not done at the valve-opening stage of the exhaust valve which can be set like an exhaust air line. Therefore, there is also an advantage of not causing aggravation of the inhalation-of-air efficiency of an internal

combustion engine. Moreover, since the operation stage (valve-opening timing) and the amount of operations (the amount of lifts) of the exhaust valve which fitted the early temperature up of the catalyst for exhaust air purification by operating an exhaust valve as independently as the usual exhaust air line can be set up, there is also an advantage that the catalyst for exhaust air purification is efficiently activable.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing typically the composition of the control system in the exhaust air valve-action control unit of the internal combustion engine as 1 operation gestalt of this invention.

[Drawing 2] It is the ** type view showing the whole internal combustion engine composition in the exhaust air valve-action control unit of the internal combustion engine as 1 operation gestalt of this invention.

[Drawing 3] It is drawing showing the timing of the cam profile in the exhaust air valve-action control unit of the internal combustion engine as 1 operation gestalt of this invention, and an ignition signal, and the temperature in a cylinder by the relation with a piston position.

[Drawing 4] It is the block diagram showing typically the valve gear of the exhaust air valve-action adjustable means in the exhaust air valve-action control unit of the internal combustion engine as 1 operation gestalt of this invention, and an inlet valve.

[Drawing 5] It is the ** type view of the exhaust air valve-action adjustable means in the exhaust air valve-action control unit of the internal combustion engine as 1 operation gestalt of this invention, and the perspective diagram in which (A) shows whole composition, drawing showing the state where a sub rocker arm does not carry out coordinated operation of the (B) with a main rocker arm with the A-A view cross section of (A), and (C) are drawings in which a sub rocker arm shows the state of carrying out coordinated operation with a main rocker arm with the A-A view cross section of (

[Drawing 6] It is the flow chart which shows the control in the exhaust air valve-action control unit of the internal combustion engine as 1 operation gestalt of this invention.

[Description of Notations]

3 Flueway

4A Exhaust valve

6 Catalyst for Exhaust Air Purification

20 ECU (Control Means)

60A Good change valve system (exhaust air valve-action adjustable means)

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CLAIMS

[Claim(s)]

[Claim 1] When there are an exhaust air valve-action adjustable means for an exhaust air line to operate this exhaust valve apart from the operation of the exhaust valve at the time, and to get in the internal combustion engine which offered the catalyst for exhaust air purification on the flueway, and a temperature up demand of this catalyst for exhaust air purification, The exhaust air valve-action control unit of an internal combustion engine characterized by having offered the control means which are after ignition and control this exhaust air valve-action adjustable means that the valve-opening operation of this exhaust valve should be temporarily carried out before an expansion-stroke end.

[Translation done.]

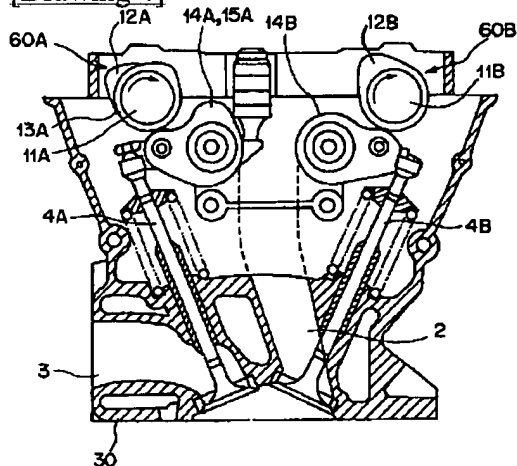
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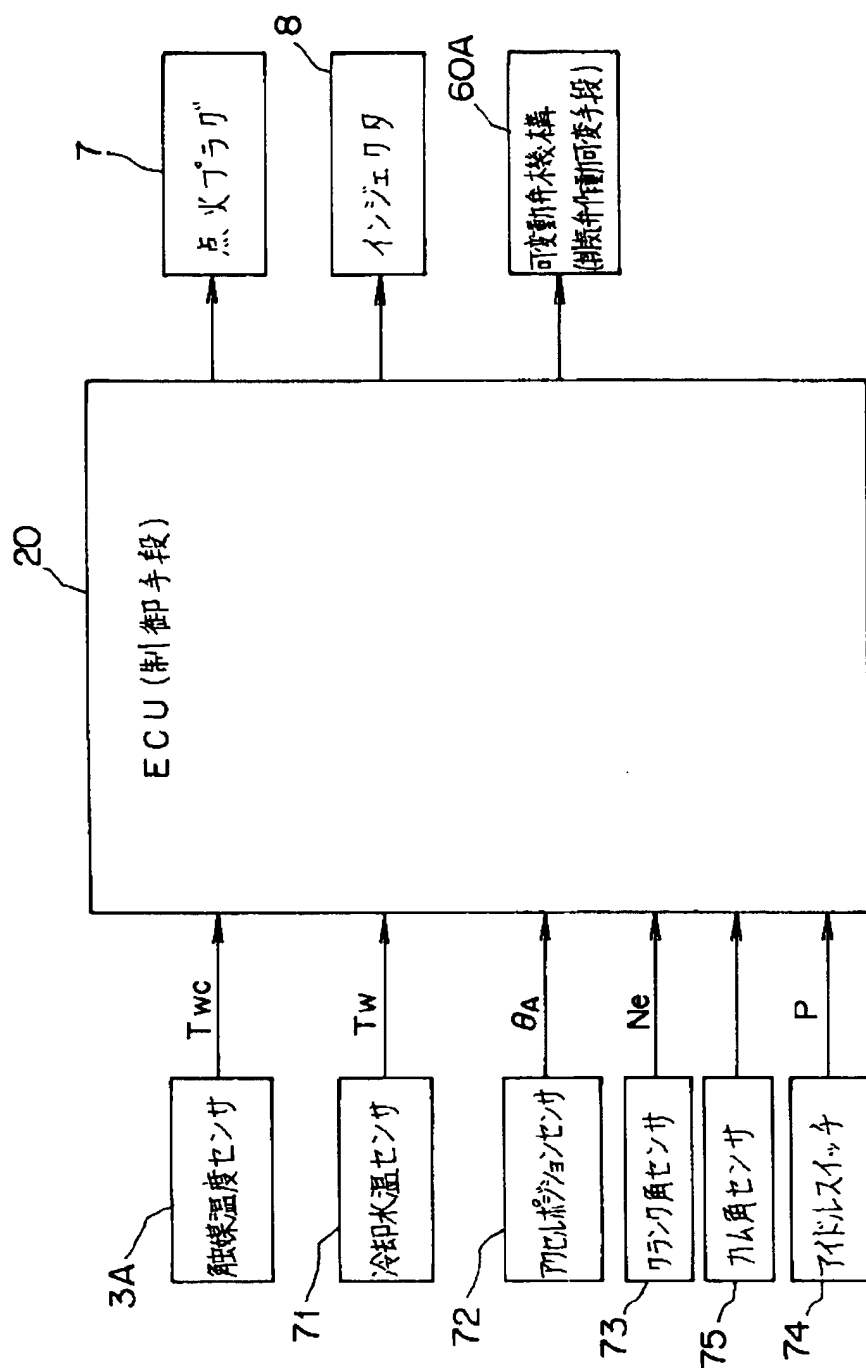
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DRAWINGS

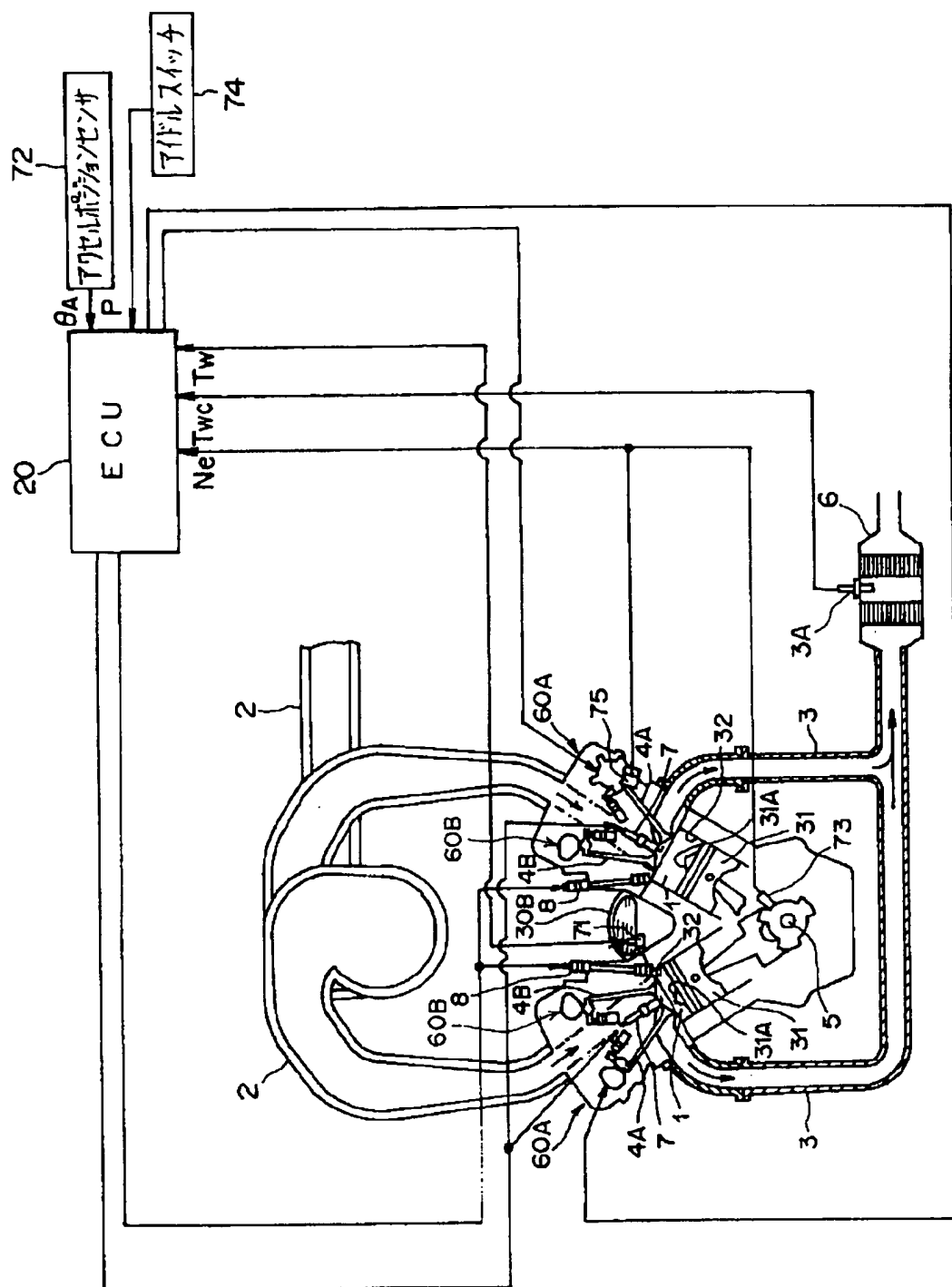
[Drawing 4]



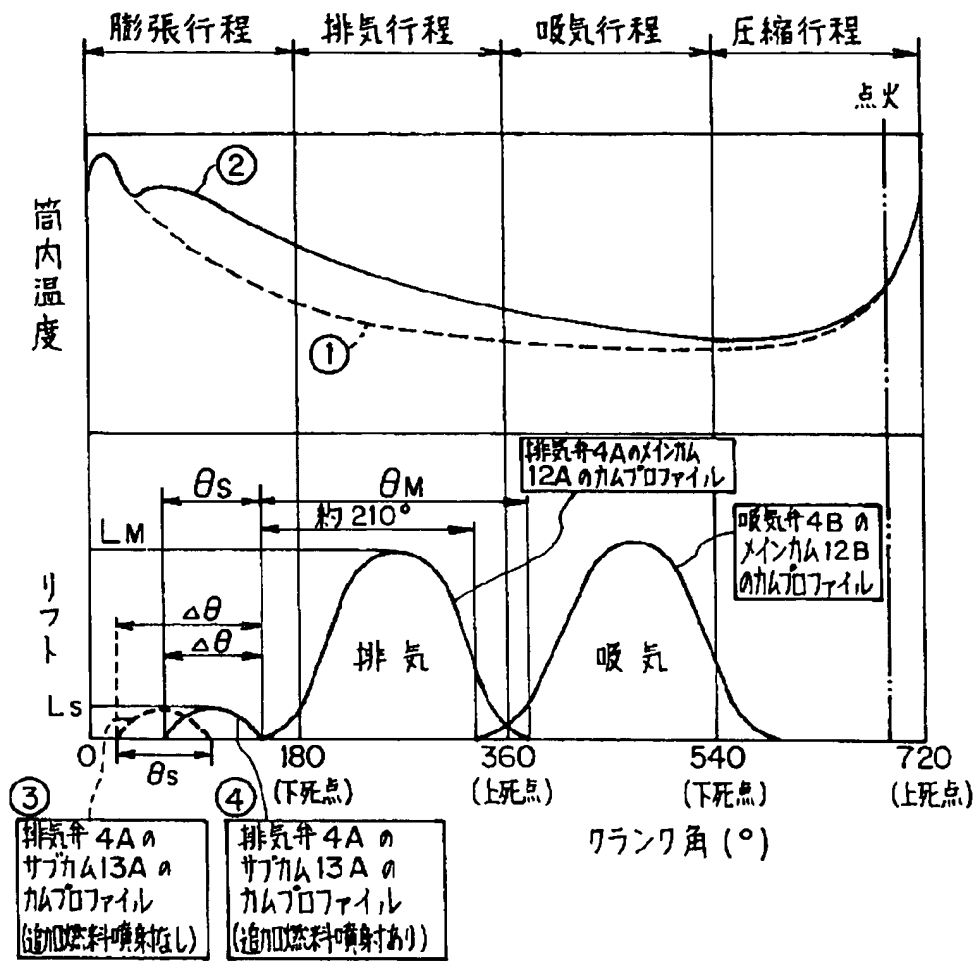
[Drawing 1]



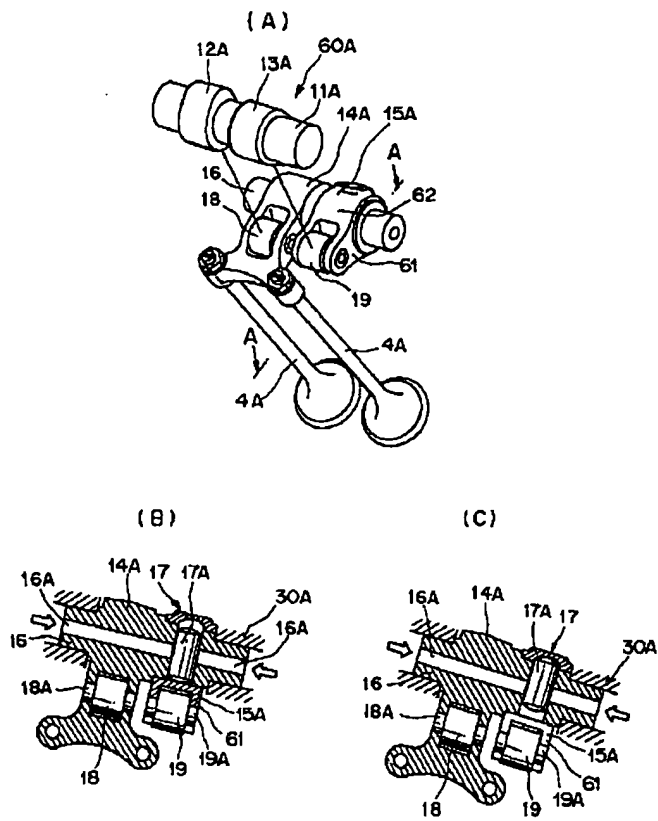
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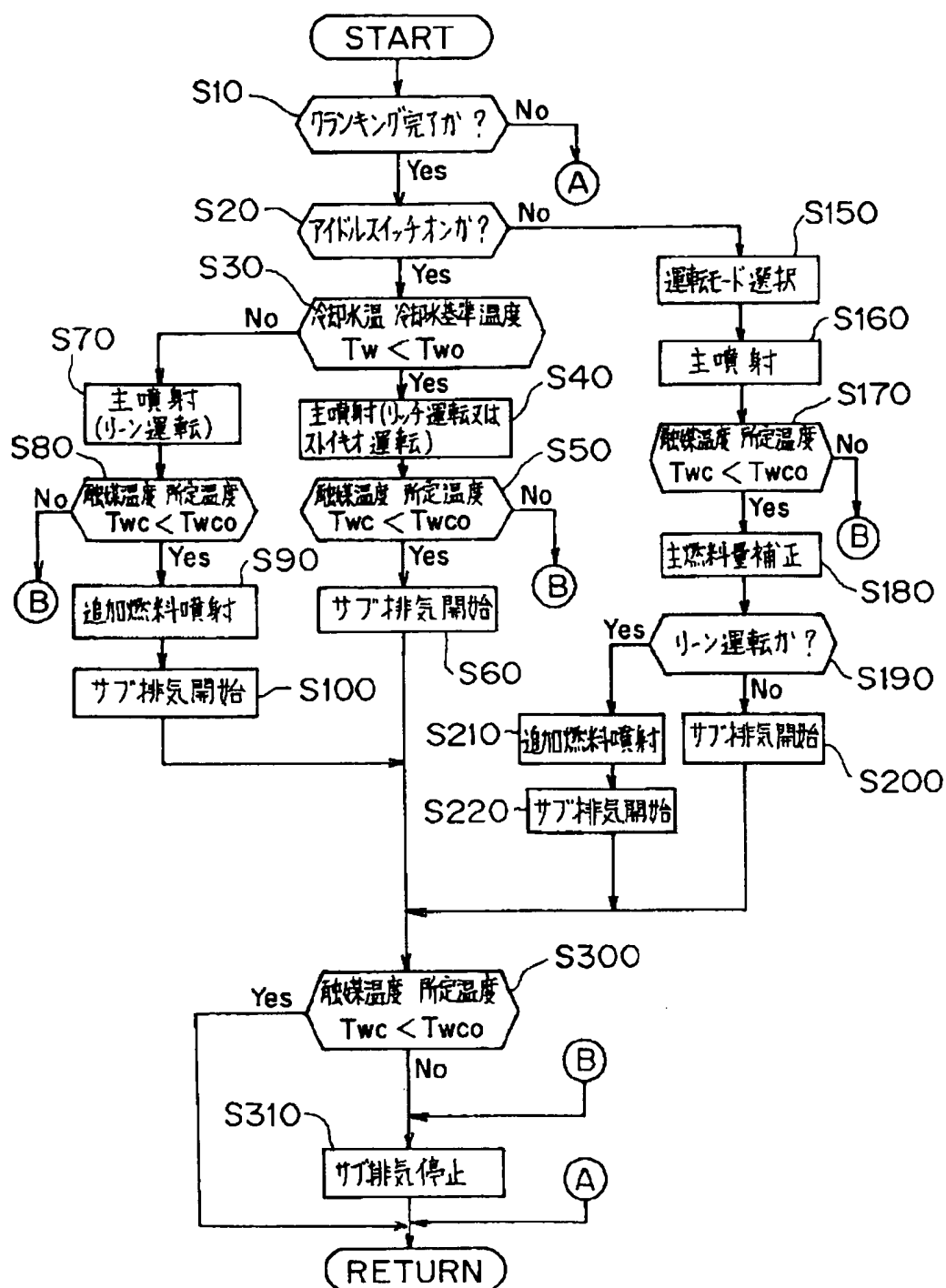
[Drawing 3]



[Drawing 5]



[Drawing 6]



[Translation done.]